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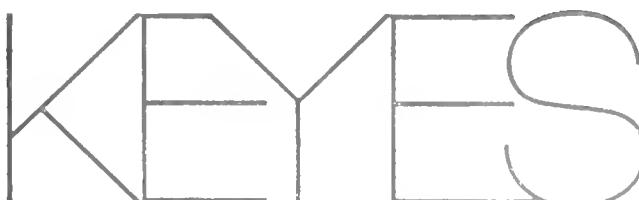
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Garages

Parking Garage Study

Northeastern University

A study done in association with
VANASSE/HANGEN ASSOCIATES, INC.
Transportation Engineers & Planners



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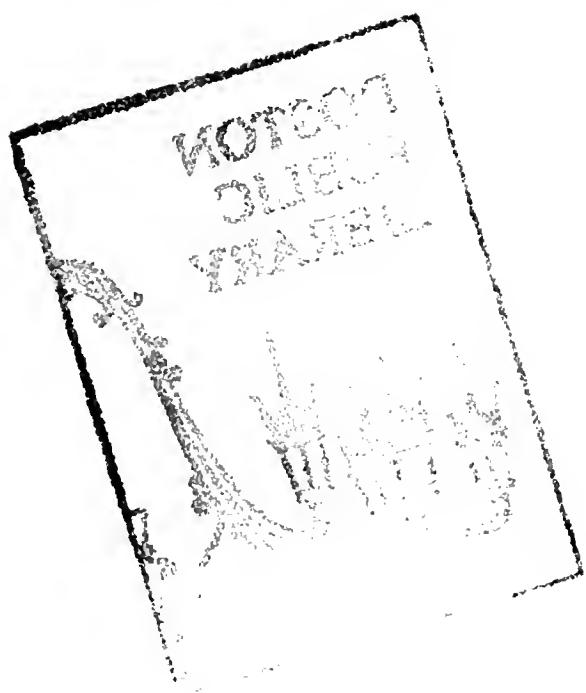


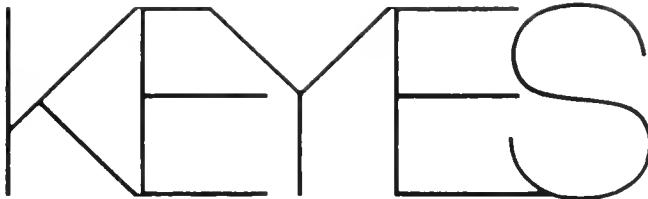
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Keyes Associates — Architects/Engineers/Planners

March 8, 1983
"Our Thirty-Second Year"

Mr. Clifford FraLEN
Director of Physical Plant
Northeastern University
26 Tavern Road
Boston, MA 02115

SUBJECT: Parking Garage Study

Dear Mr. FraLEN:

KEYES Associates is pleased to present the above study involving the site location and preliminary design for a 500 car parking garage to be located on University property off Columbus Avenue adjacent to the Southwest Corridor Project. During the course of our investigations we worked closely with Vanasse/Hangen Associates, Traffic Consultants, on vehicular and pedestrian circulation; with Haley and Aldrich on soils analysis and with your office for overall coordination.

The study included an evaluation of several different garage configurations to determine which would most closely satisfy the special requirements of the site. We have selected one of these alternate designs for your consideration and include cost estimates and a building systems description for the proposed facility. Recommendations were also made during the course of our study pertaining to the location and design of the pedestrian bridge to be constructed by the MBTA.

We look forward to a successful conclusion of negotiations by Northeastern University with the Authority and to continuing our efforts on the final design for the garage project.

Sincerely yours,

KEYES ASSOCIATES

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NORTHEASTERN UNIVERSITY
PARKING GARAGE STUDY

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A. Campus Parking Space Analysis

The initial task in the study involved the review of all parking spaces presently available on the Campus and an analysis of spaces lost in the construction of the Southwest Corridor Project, the Engineering Building and the proposed Library and Recreation Center projects. In order to maintain existing total of approximately 3010 parking spaces, it was determined that a parking garage for approximately 500 cars will be required on Parcel 17X in the immediate future (Phase I); and that a future expansion of that garage (Phase II) of approximately 520 cars will be required when the Library (Initial Phase) is constructed. A future garage for 400 cars would be needed if the proposed Library Addition and Recreation Center were constructed. This garage (Phase III) would be located in the Parker Street-Field Street area for better Campus parking distribution.

TABLE 1. PARKING SPACE - LOSS AND GAIN

| | N.U. Parking Loss | Public Parking Loss | N.U. Parking Gain | N.U. Subtotal | Garage Parking Gain | N.U. Total |
|--|-------------------|---------------------|-------------------|----------------|---------------------|------------|
| Engineering Center | -128 | | | -128 | | -128 |
| Parcel X 2 (S.W. Corridor) | | | 221 | 93 | | 93 |
| Garage Phase I (502) | | | | | 390 | 483 |
| Southwest Corridor SW 201 - 238 Tavern, Camden, etc. | -863 | -149 | 248 | -522 | | -132 |
| Garage Phase II (519) | | | | | 406 | 274 |
| Library Phase I | -220 | | | -742 | | 54 |
| Garage Phase III (400) | | | | | 310 | 364 |
| Recreation Center | -299 | | | -1041 | | 65 |
| Library Phase II | -84 | | | -1125 | | -19 |
| Street Closings (tentative) Tavern Road Field Street | | -41 -43 | 58 66 | -1067 -1001 | | 39 105 |

NOTE: The precise timetable for each of these projects is yet to be determined.

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B. Site Planning

The first step in determining the optimal location for the proposed parking garage involved an examination of the existing site boundaries and characteristics.

The parcel, as shown on Site Plan (Drawing 1) is approximately 281,000 SF of land, bounded by the Southwest Corridor tracks, the new Ruggles Station and its approach road - Columbus Avenue and by the Carter Playground and Camden Street. Plans have been completed by the City for reducing the width of Columbus Avenue and include the provision of a 30' wide strip of land along the street - from the Carter Playground to St. Cyprian Street - in which will be located a bicycle path, sidewalk and landscaping.

The site is essentially flat, with grades ranging in elevation from 9'-11.5', National Geodetic Vertical Datum. The Ruggles Street Station will contain a bus ramp along the southwest edge of the site with a maximum elevation of 27.6' as it crosses the rail and transit tracks. The soil characteristics in the area have been documented in the report by Haley and Aldrich dated Aug. 6, 1981. These findings have been utilized in our study and indicate that spread footings can be successfully utilized in the garage design. Subsurface drainage will be required for both the garage and parking areas; access will be available to storm drains in Columbus Avenue.

In our site location studies for the garage, the following design criteria were utilized:

- Traffic control.
- Pedestrian circulation.
- Surface parking efficiency.
- Expandability of the garage.
- Visual factors - scale and exterior appearance.

A number of site locations and garage circulation systems were reviewed; six most promising alternatives were subjected to further scrutiny in meetings held with Transportation Planning Consultants, Vanasse/Hangen Associates. Their studies indicated that a significant amount of roadway length will be required within the site for stacking of vehicles entering the garage and surface parking areas. This requirement favored the construction of the "two-bay" garage layouts (122'wide) since the "three-bay" types utilized too much of the available site width, leaving insufficient land for properly engineered roadway design and surface parking layouts.

The Vanasse/Hangen report also illustrates the recommended location for ingress and egress driveways from Columbus Avenue. It is assumed that all incoming traffic of the site will be controlled from one set of gates and that the entire site will be fenced for security reasons. Several alternative locations for the two-bay garage were examined. The final recommended siting for the Phase 1

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garage was based on the most effective initial and long-term distribution of vehicles in the site and the location of pedestrian bridges across the tracks to the campus. There will be three bridges constructed by the MBTA as part of the Corridor Project; the first bridge will be located adjacent to the Ruggles Station bus ramp; the second at Camden Street; the third bridge was to be sited by the University. The best location for this bridge was determined to be opposite the roadway between the Ell Center and Robinson Hall, thereby providing easy access to the center of the campus and its tunnel system.

Sketches were prepared for the bridge location and its connection to the garage; these documents were forwarded through the University to PRC Harris, engineering consultants for the project. Design modifications for the bridge were also included since the proposed design (by the MBTA) was particularly unattractive; Keyes feels that the University should make a strong effort to upgrade the bridge design as recommended, since it will be a focal point for campus circulation for many years in the future. The bridge will connect with the third level of the proposed five-level garage (four decks above grade), and be reached by both the stairways and ramps to be constructed by the MBTA.

C. Garage Design & Construction

As stated earlier, KEYES considered many garage circulation schemes (See Alternate Garage schematics in Appendix). The most effective garage layout, based on all design criteria, was the two-bay split-level design shown on the enclosed drawings.

The 502-car capacity can be accommodated in Phase I, with a one-way traffic system utilizing up and down ramps at each end of the structure. As shown one of the ramps would be constructed at 25'-6" wide (instead of the normal 17'-0") to allow for a direct "exit spiral" when the Phase III garage is constructed. During our studies, we encountered some degree of difficulty in designing a garage which functions equally well in both Phases I and II. We feel, however, that the split level design will work most effectively in solving the following design requirements:

1. Filling up from the ground level-both phases, using student monitors.
2. No dead ends at the top floors (as found in sloping floor garages).
3. Ease of monitoring for security (split-levels are open, allowing visual access between levels).
4. Flat floor circulation to the stairs and bridges.
5. Attractiveness of the exterior design; no sloping facades.

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TABLE 2. GARAGE SPACE AND PARKING COUNT

| PARKING SPACES | PHASE I | PHASE II | TOTAL |
|-------------------|-------------|-------------|-------------|
| GROUND | 94 | 99 | 193 |
| FIRST | 102 | 105 | 207 |
| SECOND | 102 | 105 | 207 |
| THIRD | 102 | 105 | 207 |
| FOURTH | 102 | 105 | 207 |
| TOTAL | 502 | 519 | 1021 |
| FOOTPRINT AREA | 33,611 | 31,899 | 65,510 |
| FLOOR AREAS | | | |
| FLAT PER LEVEL | 29,862 | 29,740 | 59,602 |
| X NO. OF LEVELS | <u>X 5</u> | <u>X 5</u> | <u>X 5</u> |
| TOTAL FLAT | 149,310 | 148,700 | 298,010 |
| RAMPS | 13,940 | 7,480 | 21,420 |
| TOTAL | 163,250 | 156,180 | 319,430 |
| SQUARE FEET/SPACE | 325 | 301 | 313 |

The height of the garage at 44' (to the parapet wall) was determined to be in scale with the Ruggles Street Station (approximately 46' roof height) and nearby University buildings. The five-level design also occupies less land area than lower height garages thereby allowing a greater number of surface parking spaces.

The garage location, 17' from the "boat wall" of the Southwest Corridor, is sufficient for the placement of the spread footings and the pedestrian bridge ramps. Further study will be required on the effects of air and noise made by trains passing on the adjacent tracks since in the new design the south wall of the Corridor has been designed at a lower height than the north wall adjacent to the Campus (See Garage Section - Drawing 4).

The City of Boston requires that all garages be properly designed for fire resistance. Several construction systems have recently been utilized to meet this requirement; precast- prestressed concrete, the filigree-system, cast-in-place concrete, and fireproofed steel framing. KEYES, in conjunction with the Vappi Construction Company examined each of these systems and recommend the precast-prestressed system for reasons of initial cost, maintenance and overall appearance.

The garage would be constructed of precast-prestressed columns, spandrel beams and precast double tee beams, similar to the garage at the Winchester Hospital which was visited by a team from Northeastern University. The spandrel beams would be designed for attractive appearance with a pattern of smooth and textured concrete (either sandblasted or board-formed). The 4" thick double

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tee beams form the wearing surface for the upper decks of the garage. These members are constructed with high strength (5000#) concrete and do not require a topping (such toppings have been subject to cracking in this climate). A special compound is used to seal the joints between the tees.

The lower or ground levels of the garage would be constructed utilizing bituminous concrete paving. Striping would be provided at all levels. High intensity discharge lighting units would be installed between the tee-beams at all levels creating a very economical and attractive lighting system for the structure. On the top deck, either wall mounted lighting units or low-pole units would be used. The stairwells would be constructed of concrete masonry units, either painted or finished with a Dryvit system exterior facing depending on final design concept. Trench drains would be installed at each level of the structure and brought to 5' outside the building line under the price shown on the cost estimate sheet. The drainage system connecting the garage to the street would be priced under the Site Development Budget. Fire Protection would include the standpipes required by the City of Boston. Painting of the stairwells is included, as is a budget for signage throughout the structure. Allowances are listed for landscaping and parking equipment.

D. Cost Estimates

The cost estimates listed below were prepared jointly by KEYES and VAPPI. The overall site work estimate was compiled by using a cost-per parking space figure based on our experience on other recent jobs. The site work would include bituminous paving over all areas except the Phase II garage site (which would remain as a gravel surface), drainage, lighting, striping and landscaping. It does not include the site fencing, since final determination of height, etc. has not been made to date. The garage estimates were prepared using recent experience by both the KEYES and VAPPI organizations.

TABLE 3. PRELIMINARY ESTIMATE

| | | | |
|------|-------------------------|--|--------------|
| I. | SITE WORK | | \$425,000 |
| II. | PARKING GARAGE | | 3,160,700 |
| | SUB TOTAL A | | \$ 3,585,700 |
| III. | CONTINGENCY - 3% | | 107,000 |
| | | | \$ 3,692,700 |
| IV. | A/E FEES - 5.2% | | 192,000 |
| | | | \$ 3,884,700 |
| V. | MISCELLANEOUS COSTS | | |
| | BORING, TESTING, PRINTS | | 26,000 |
| * | TOTAL COST | | \$ 3,910,700 |

* Estimates based on 1983 award of contract. Cost for security fencing not included.

NORTHEASTERN UNIVERSITY
PARKING GARAGE STUDY

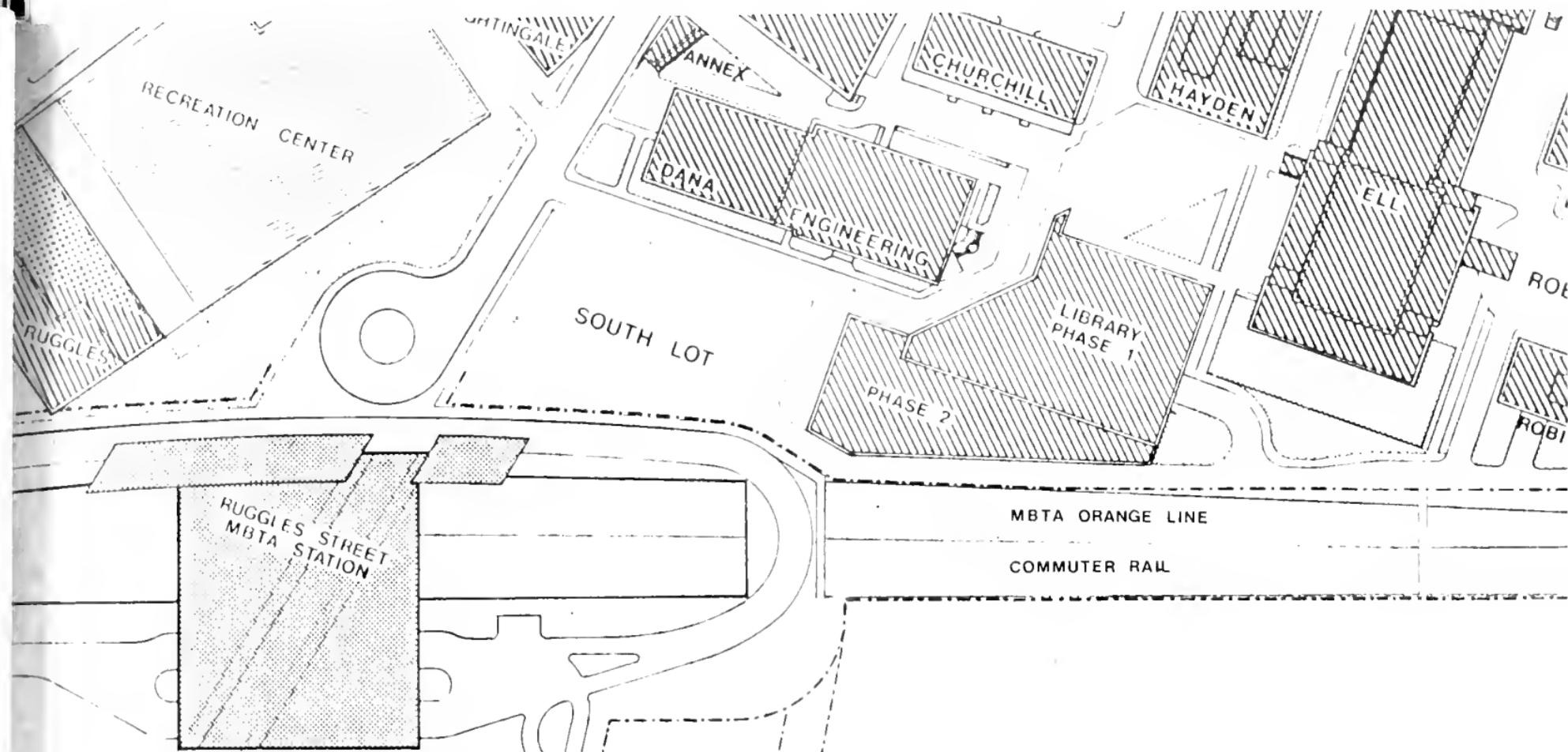
TABLE 4. Garage Estimates Cost Comparison

NORTHEASTERN UNIVERSITY PARKING GARAGE

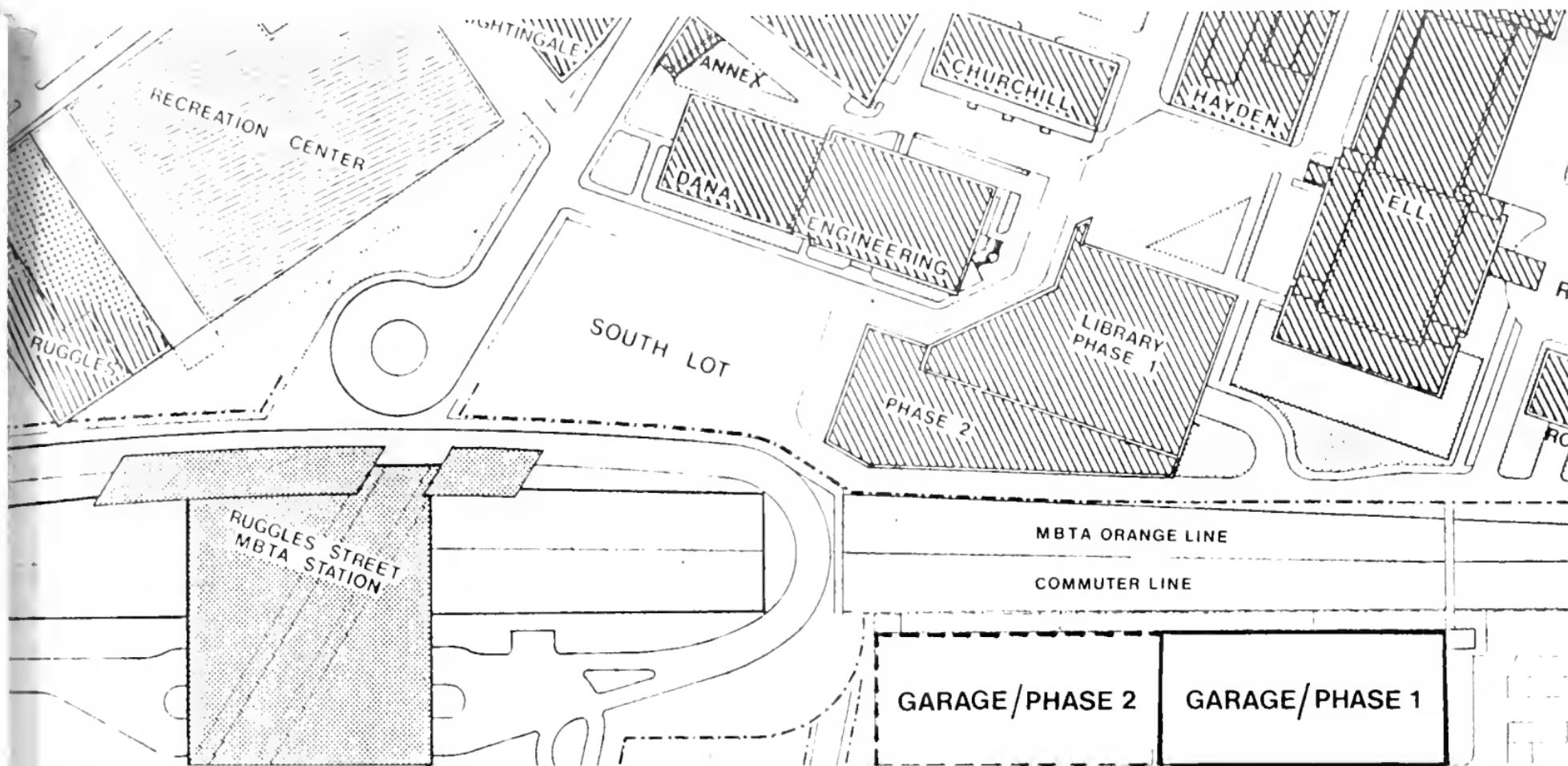
| ITEM | PRECAST | FILIGREE | C.I.P. | FIREPROOFED STEEL |
|-----------------------------|----------------|----------------|----------------|-------------------|
| Earthwork & Paving | 124,500 | 124,500 | 124,500 | 124,500 |
| Concrete & Re-Bar | 286,300 | 311,500 | 311,500 | 311,500 |
| Structure | 1,925,000 | 1,972,700 | 2,051,600 | 2,206,700 |
| Masonry | 40,500 | 40,500 | 40,500 | 40,500 |
| Miscellaneous Iron | 55,000 | 55,000 | 55,000 | 55,000 |
| Waterproofing | 11,400 | 11,400 | 11,400 | 11,400 |
| Caulking & Sealants | 62,000 | 36,000 | 36,000 | 36,000 |
| Doors, Frames, Hardware | 3,900 | 3,900 | 3,900 | 3,900 |
| Roofing & Flashing | 3,600 | 3,600 | 3,600 | 3,600 |
| Finishes & Graphics | 22,000 | 22,000 | 22,000 | 22,000 |
| Plumbing | 64,500 | 64,500 | 64,500 | 64,500 |
| Fire Protection | 24,700 | 24,700 | 24,700 | 24,700 |
| Electrical | 167,500 | 167,500 | 167,500 | 167,500 |
| Landscape Allowance | 10,000 | 10,000 | 10,000 | 10,000 |
| Parking Equipment Allowance | 15,000 | 15,000 | 15,000 | 15,000 |
| Sub-Total | 2,815,900 | 2,862,800 | 2,941,700 | 3,096,800 |
| Gen. Cond./Contr. Fee | <u>344,800</u> | <u>374,900</u> | <u>378,800</u> | <u>392,400</u> |
| | 3,160,700 | 3,237,700 | 3,320,500 | 3,499,200 |

Budget estimates are for the building only - 5 feet outside the structure and include adjacent landscaped area.

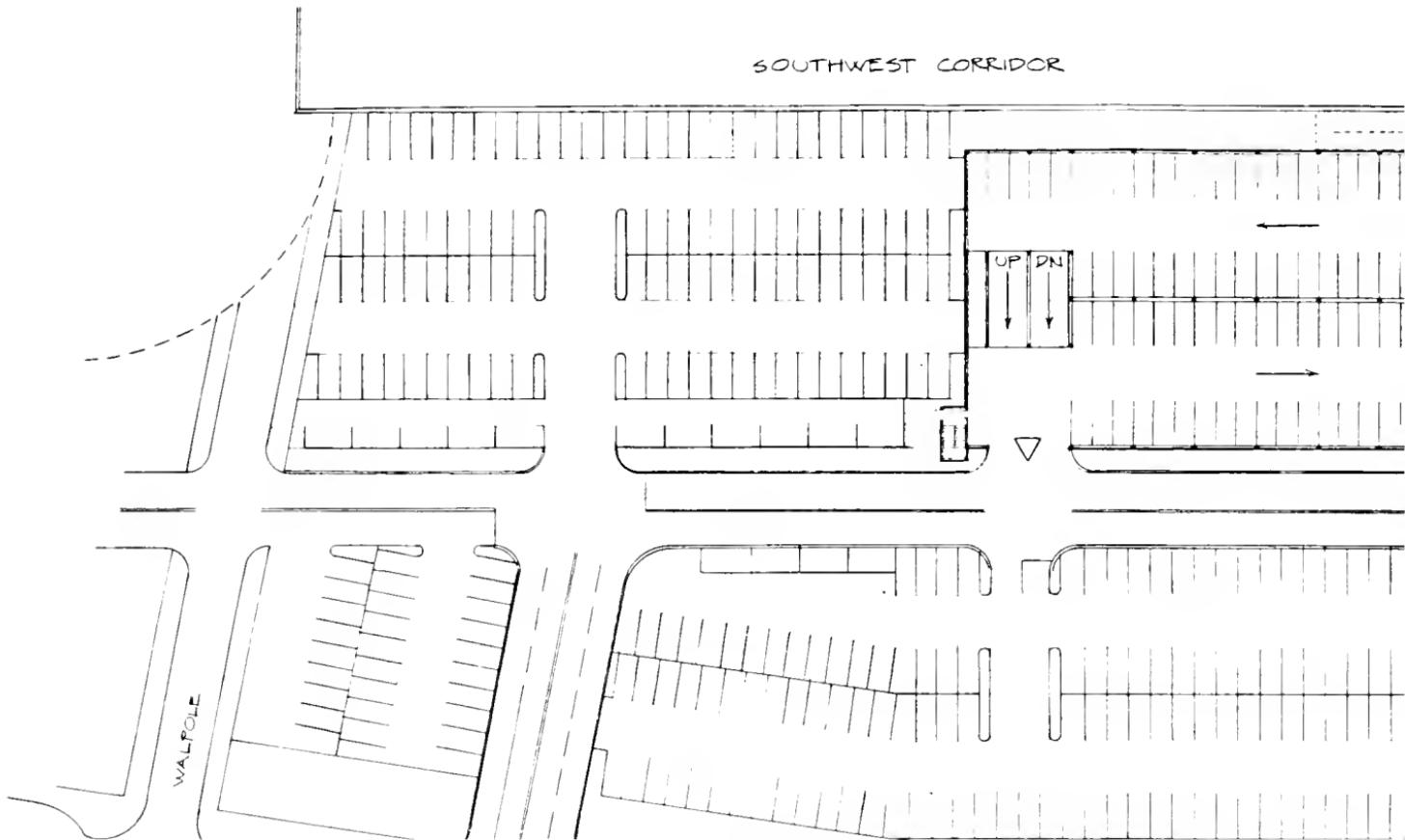
| | | | | |
|------------------|---------|---------|---------|---------|
| Cost per car | 6,296 | 6,450 | 6,615 | 6,971 |
| Cost per Sq. Ft. | \$19.36 | \$19.83 | \$20.34 | \$21.43 |



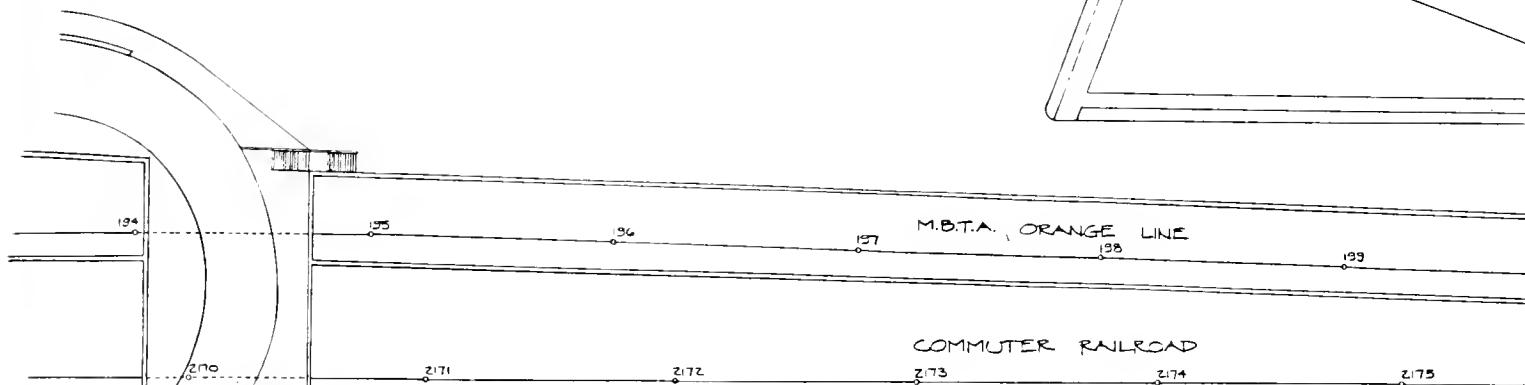




SOUTHWEST CORRIDOR



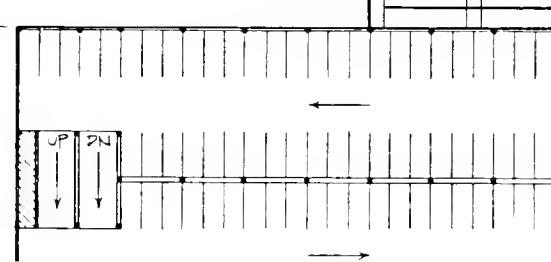
SOUTH LOT



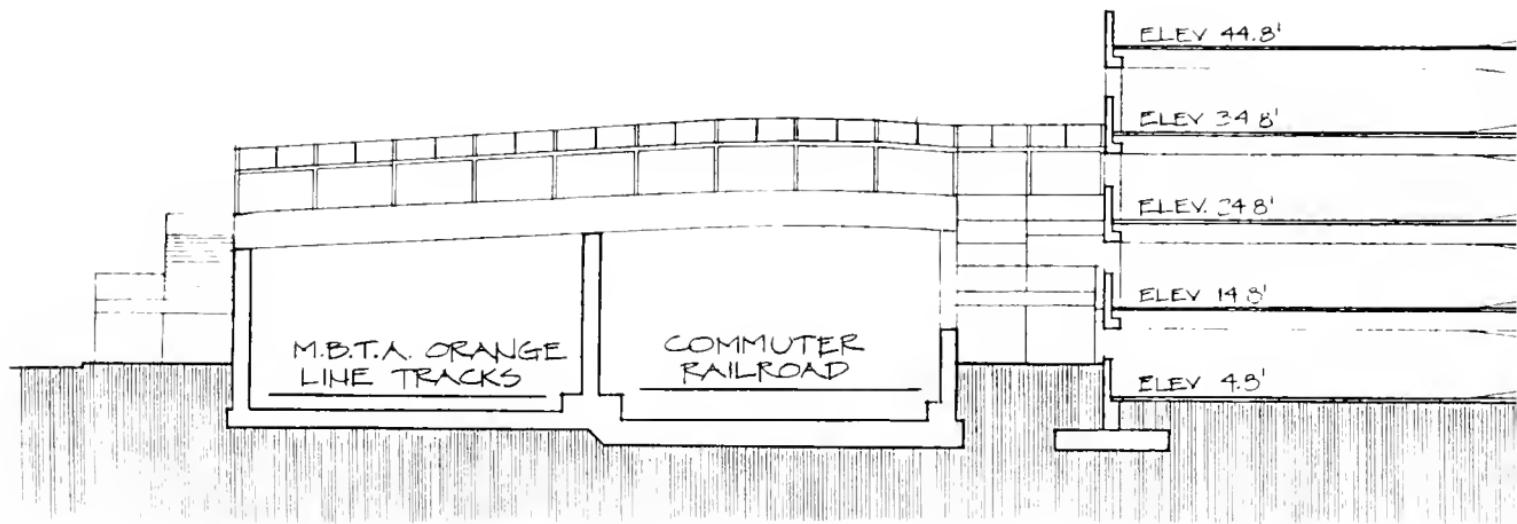
COMMUTER RAILROAD

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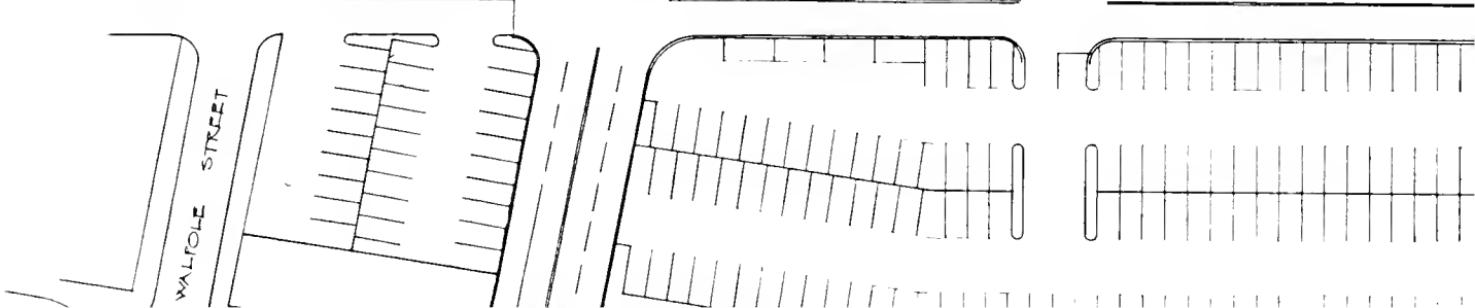
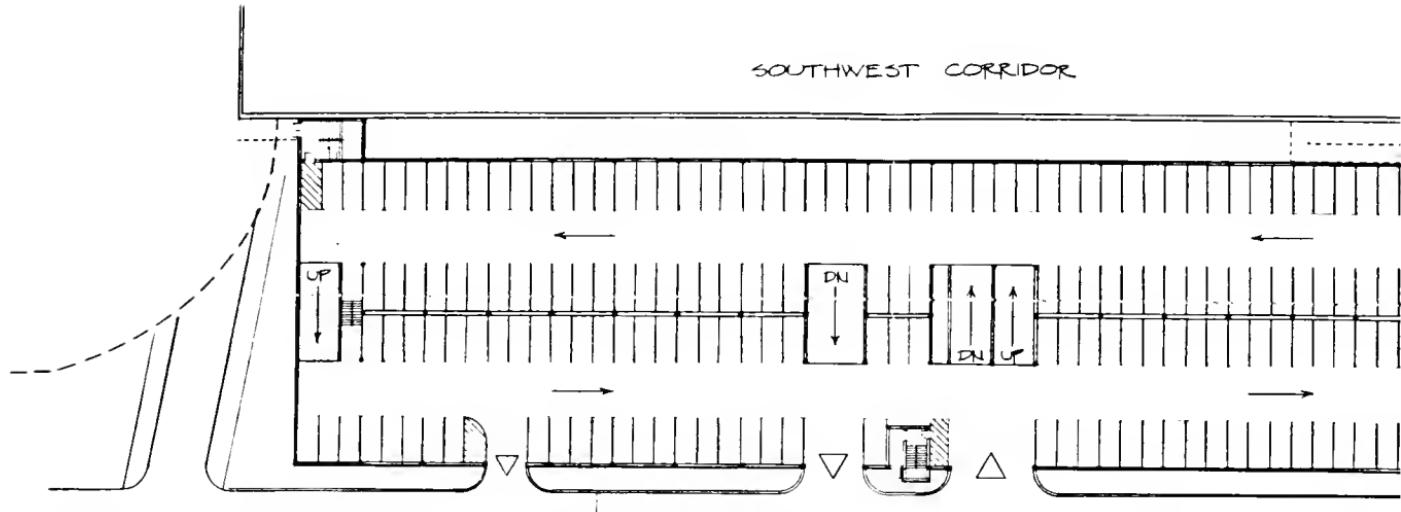
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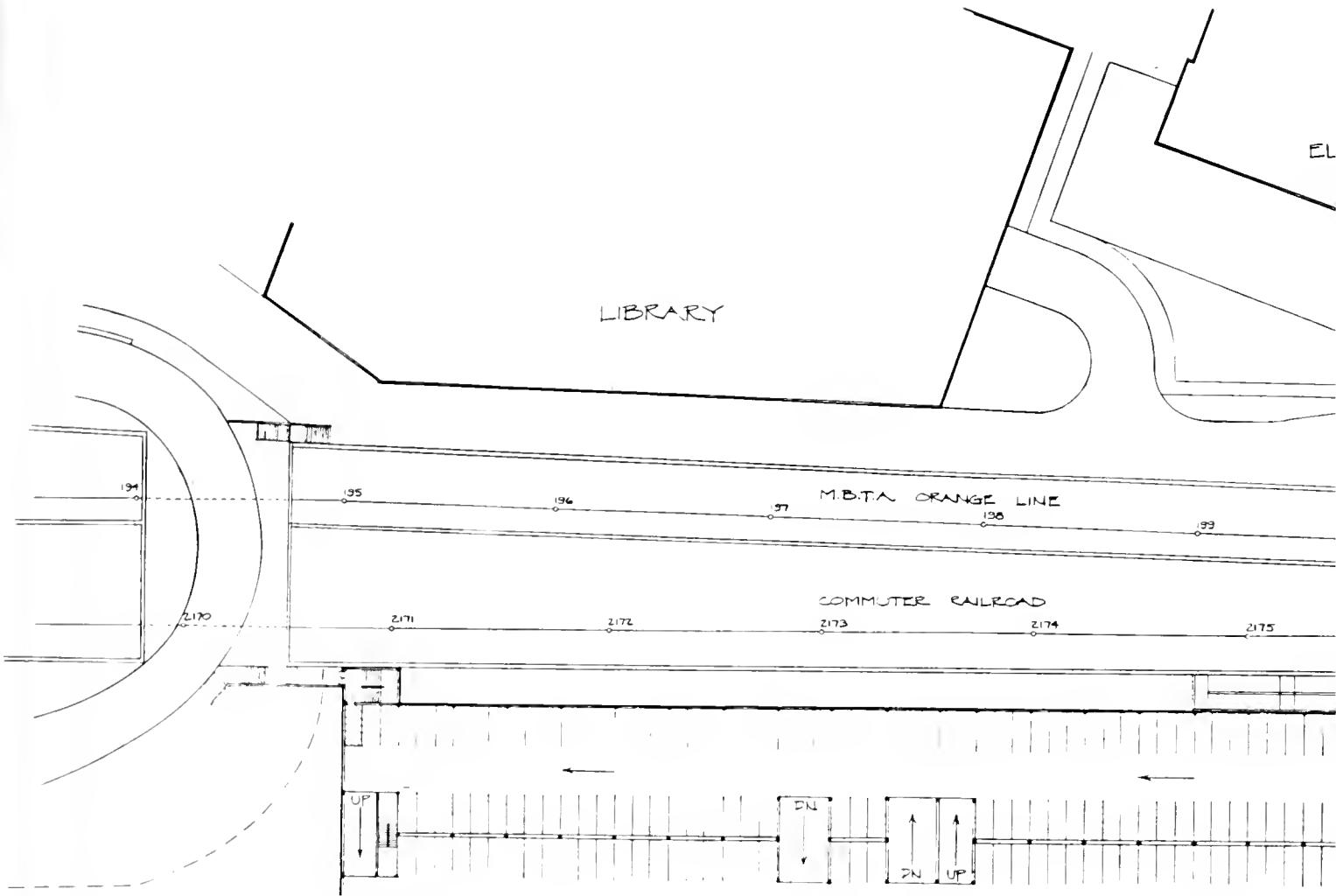


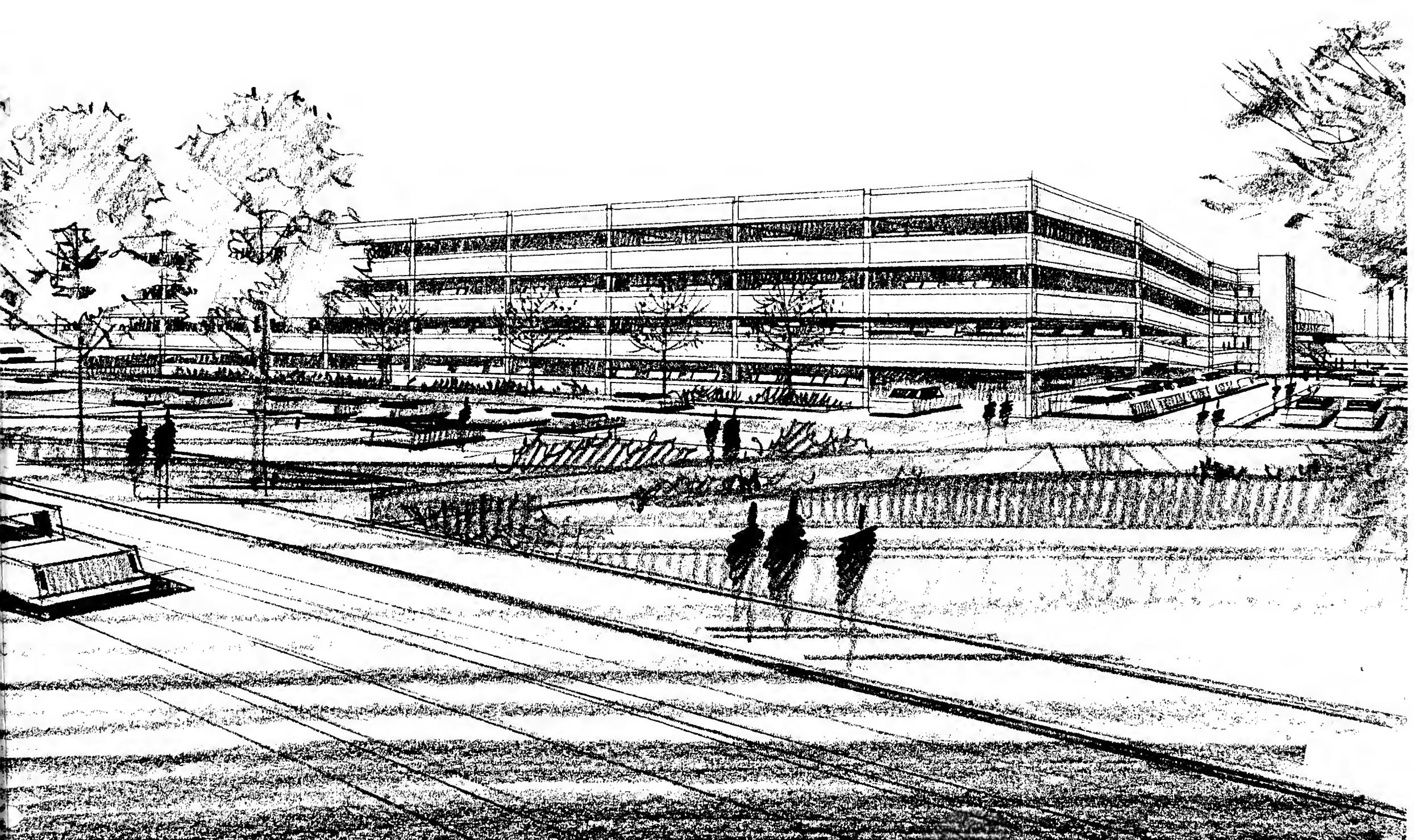
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SOUTHWEST CORRIDOR





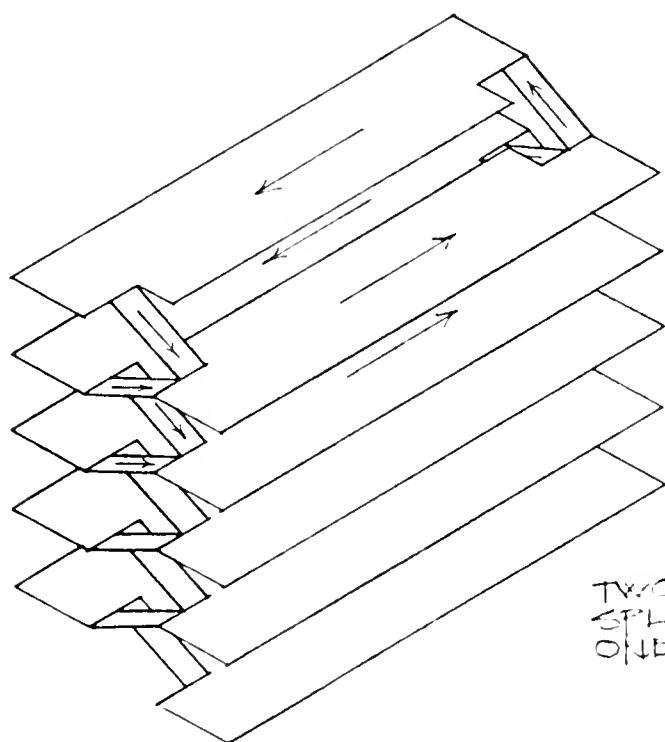


VIEW FROM COLUMBUS AVENUE

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Keyes Associates - Architects/Engineers/Planners

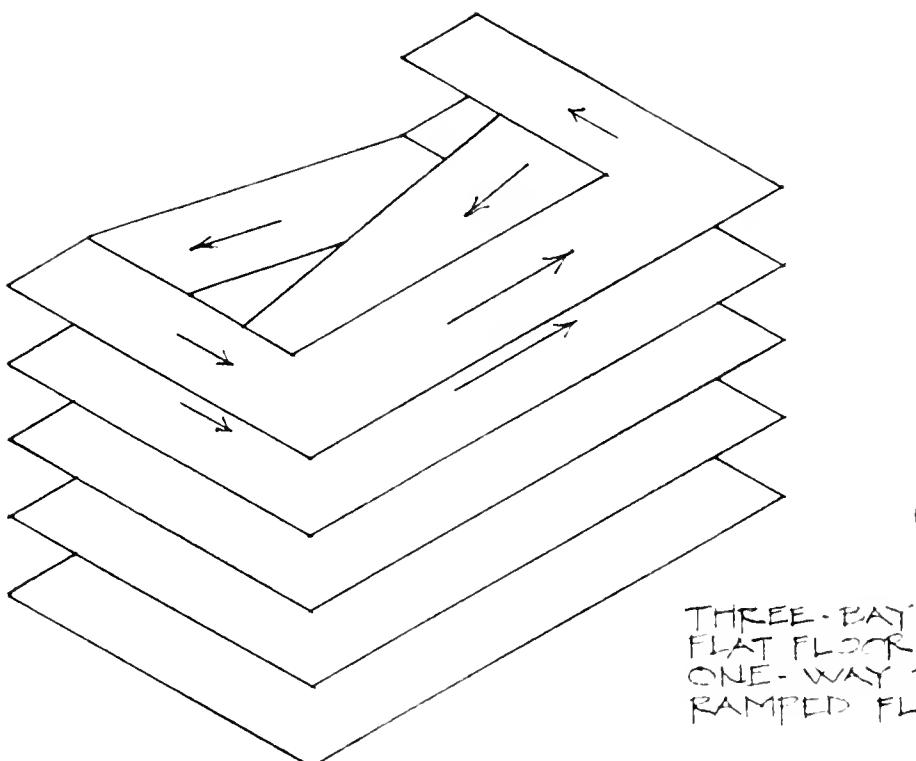
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Nashua, N.H.

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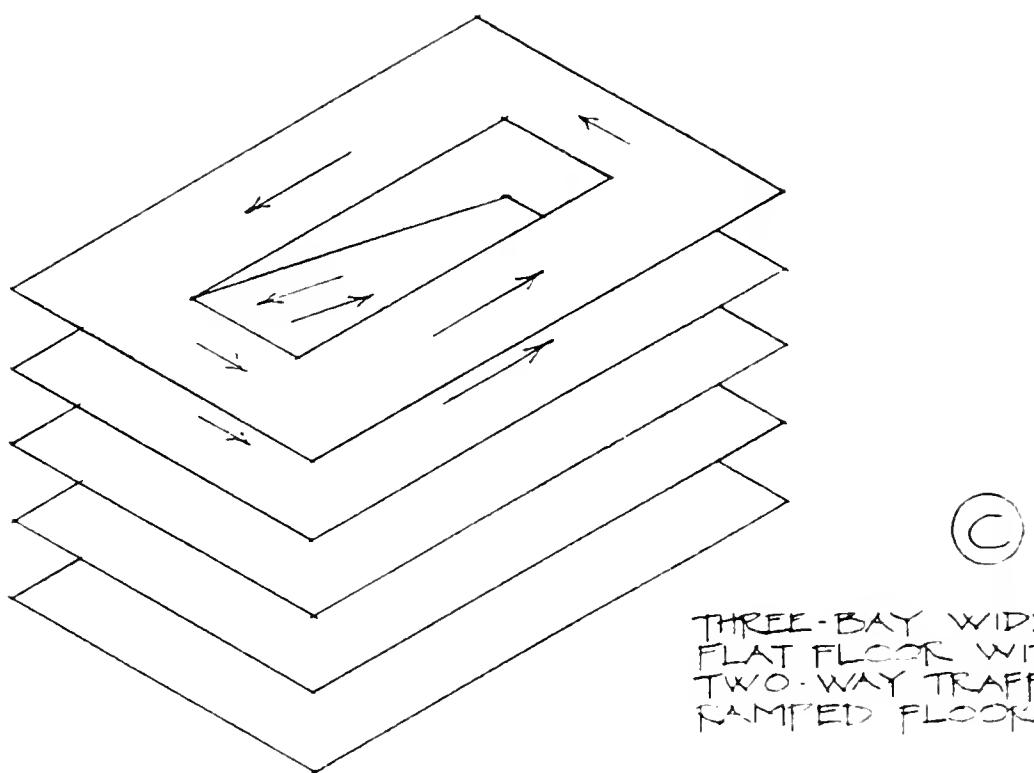


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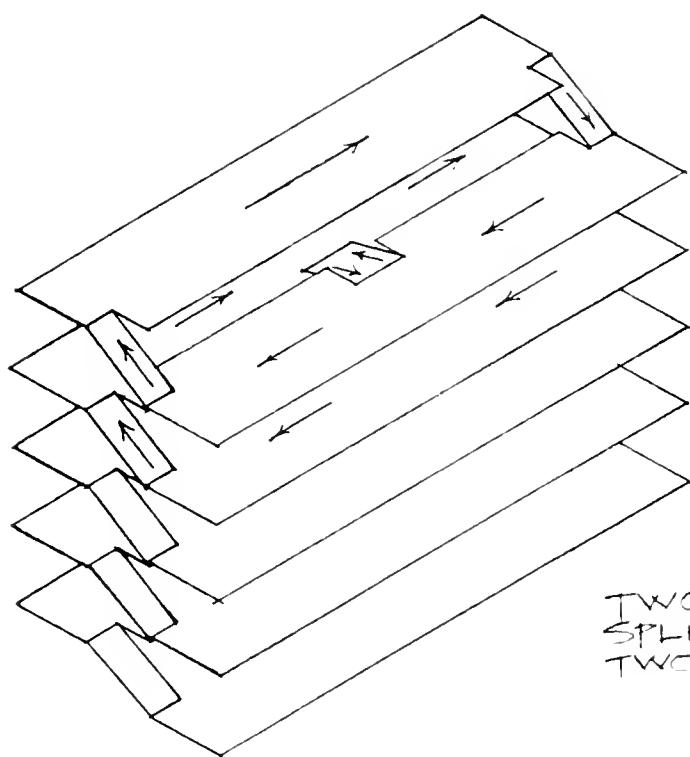
TWO-BAY WIDE
SPLIT LEVEL WITH
ONE-WAY RAMPS



THREE-BAY WIDE
FLAT FLOOR WITH
ONE-WAY TRAFFIC
RAMPED FLOORS

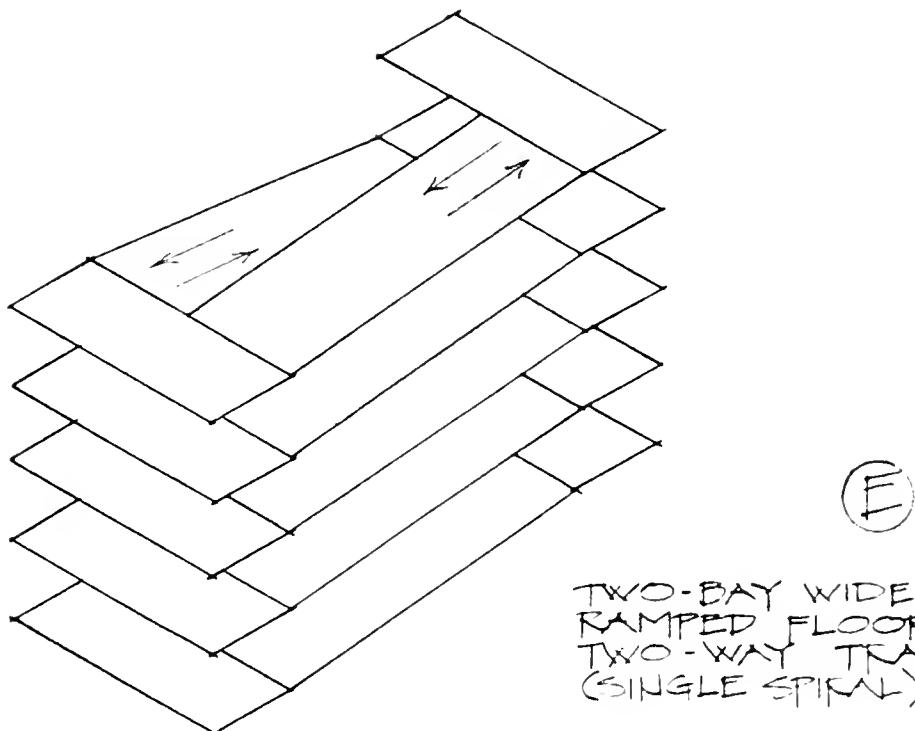


THREE-BAY WIDE
FLAT FLOOR WITH
TWO-WAY TRAFFIC
RAMPED FLOOR

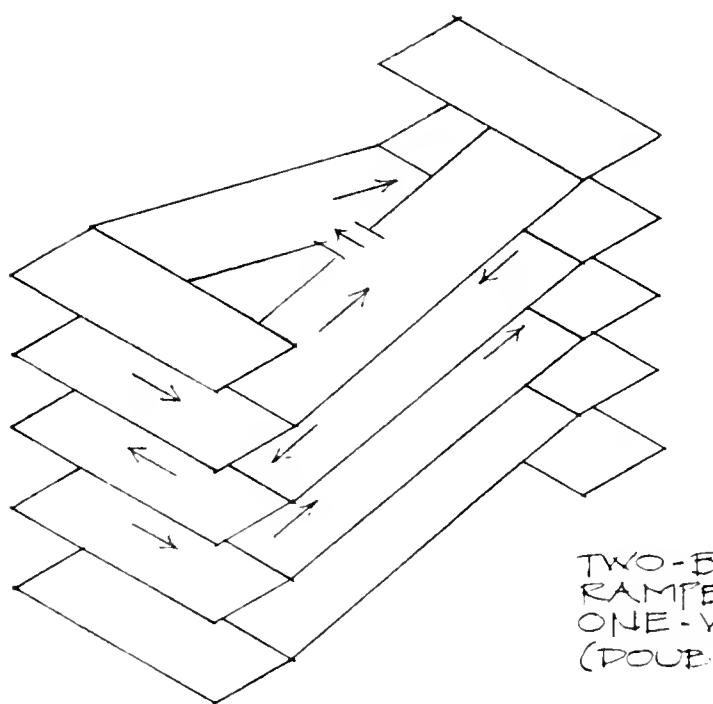


(D)

TWO-BAY WIDE
SPLIT LEVEL WITH
TWO-WAY CENTER RAMP



TWO-BAY WIDE
RAMPED FLOOR WITH
TWO-WAY TRAFFIC
(SINGLE SPIRAL)



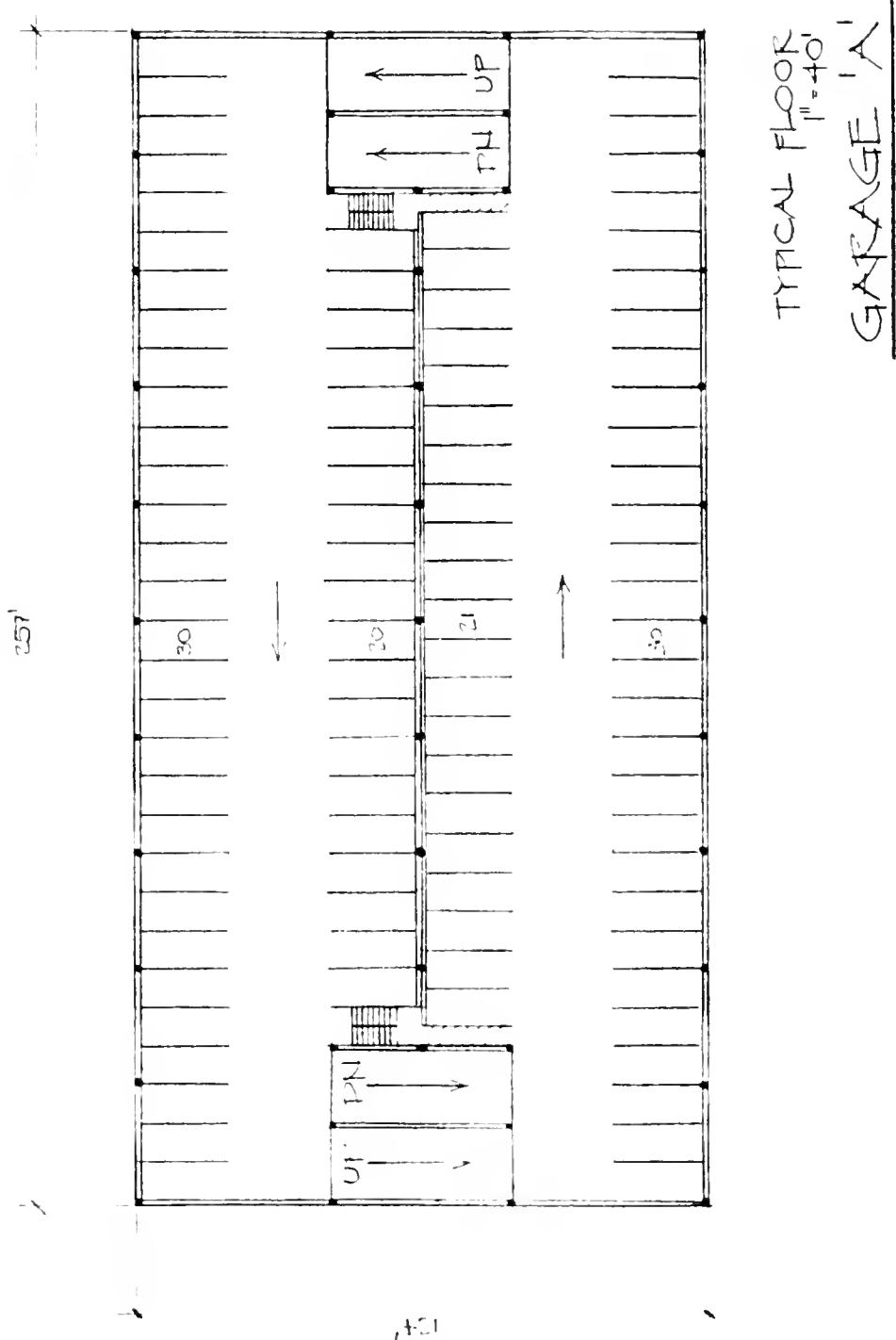
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TWO-BAY WIDE
RAMPED FLOOR WITH
ONE-WAY TRAFFIC
(DOUBLE SPIRAL)

KEYES

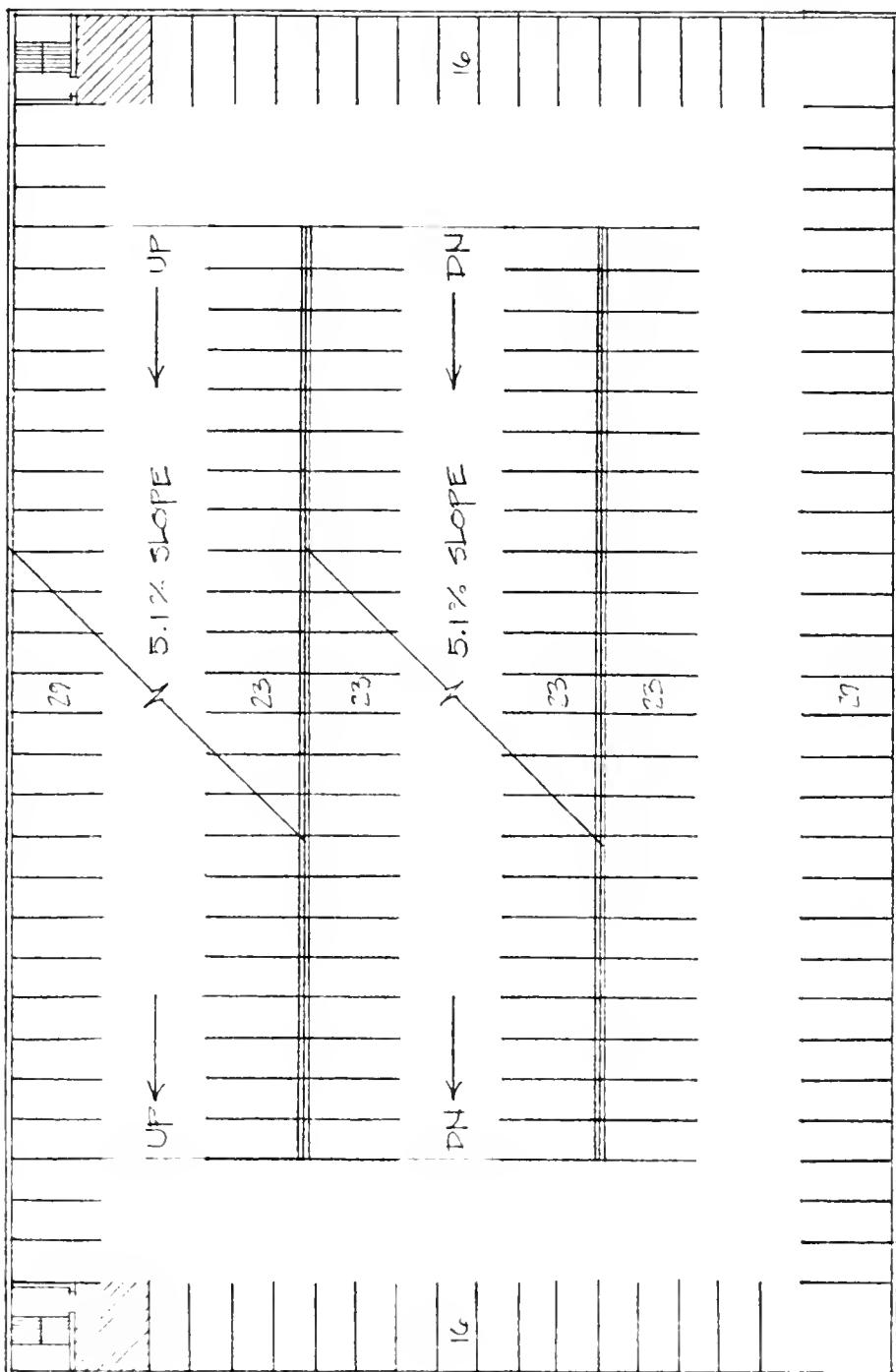
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Wethersfield, Ct.
Nashua, N.H.

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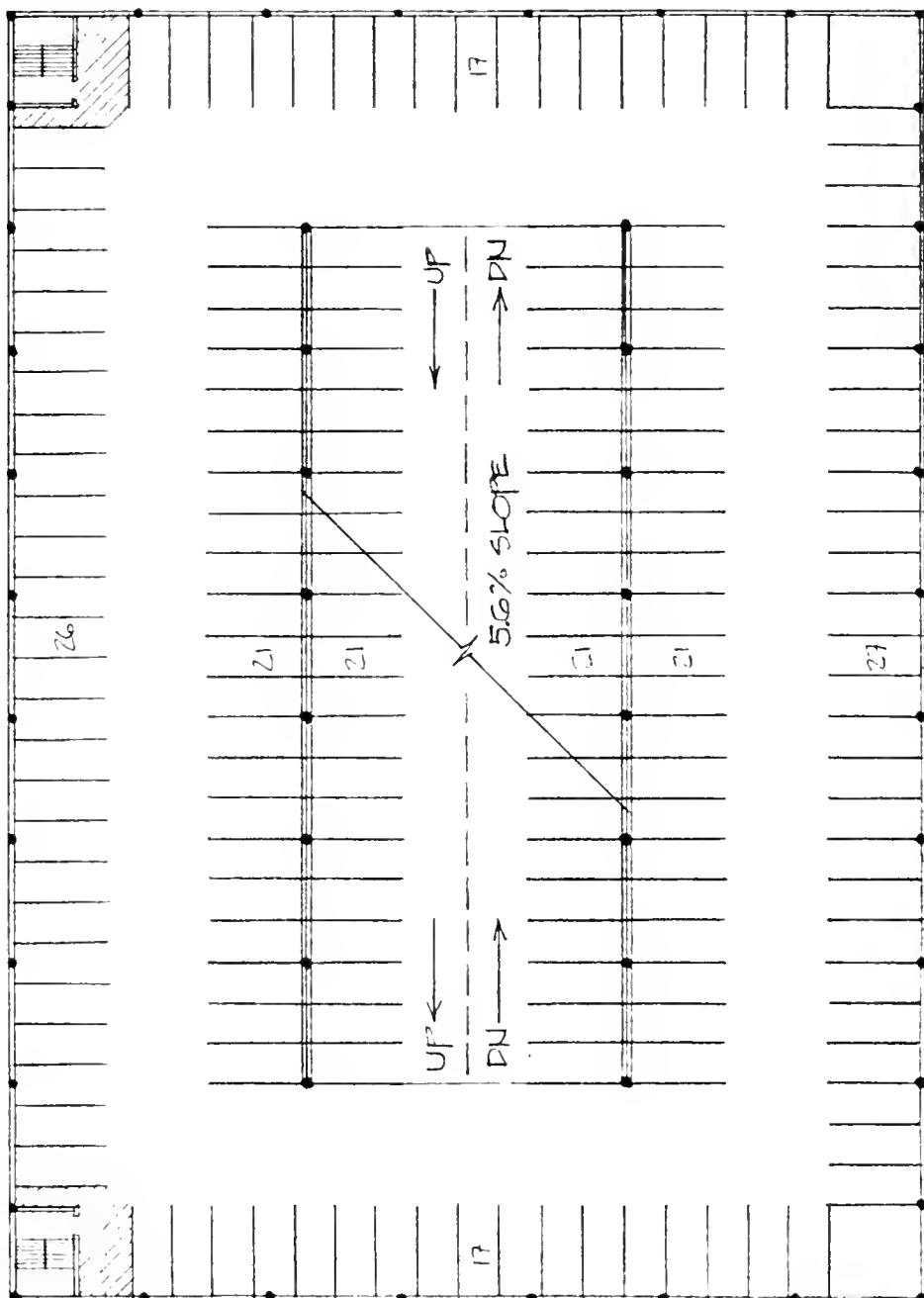


TYTICAL FLOOR
1" = 40'
GAPAGE B

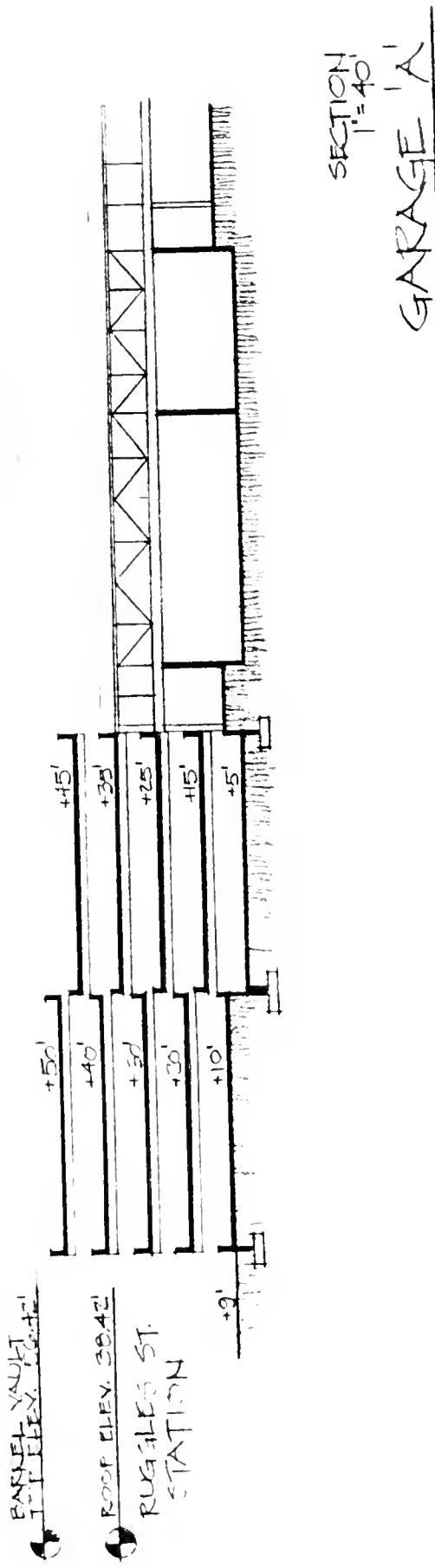


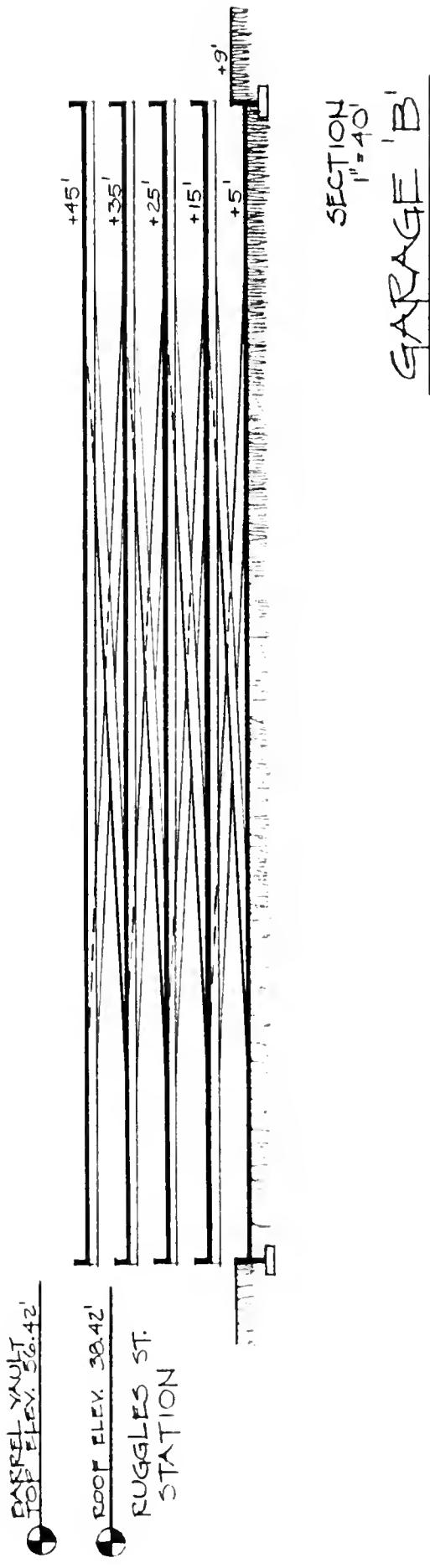
TYPICAL FLOOR
 $l'' = 40'$

GARAGE 'C'

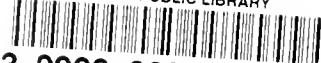


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